Oblique versus transverse anastomotic stricture in gastric pull up: an open-label controlled trial

Skośne *vs* poprzeczne zespolenie żołądkowo-przełykowe w aspekcie zwężenia w miejscu zespolenia: badanie prospektywne, z randomizacją po resekcji przezrozworowej przełyku typu *gastricpull-up*

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Abstract

Background: Survival in esophageal cancer can be improved by surgery. In the palliative surgery for esophageal cancer, the fundus is anastomosed to the esophageal remnant, which is routinely transverse after esophagectomy. Developing stricture at the anastomosis precludes recovery from dysphagia. One study on esophageal cancer showed that the occurrenceof stricture formation in transverse esophagogastric anastomosis was 13.6%. Due to high prevalence of stricture formation in transverse anastomosis, we introduced a new technique (oblique anastomosis) and compared it with routine transverse anastomosis in a prospective randomized clinical trial.

Materials and methods: This clinical trial was carried out in Imam Hospital (Tabriz, Iran) between 2003 and 2008. Two hundred subjects with biopsy-proven esophageal cancer entered the study in two groups of equal size. All patients underwent transhiatal esophagectomy (THE) and gastric pull-up. Cervical esophagogastric anastomosis randomly constructed in a transverse (T) and oblique (O) manner was completed in the two groups. In addition, two-layer hand-sewn anastomosis was done in both groups.Similar suture materials were used: non-absorbable for the posterior layer and absorbable for the inner layer.

Results: There were 117 males (58.5%) and 83 females (41.5%) with a mean age of 60.47 years (range, 28–81 years). In the six-month follow-up period, 25 (12.5%) patients had dysphagia [20 (20%) cases in group T vs. 5 (5%) cases in group O (p = 0.001, 95% CI: 0.076–0.586, OR = 0.211]. Nineteen cases (9.5%) had structural anastomotic strictures 16 (16%) cases in group T vs. 3 (3%) cases in group O (p = 0.002, 95% CI: 0.046–0.577, OR = 0.162).

Conclusion: This study showed that stricture formation was significantly lower in oblique esophagogastric anastomosis

Streszczenie

Wstęp: Zabieg chirurgiczny może zwiększyć szansę przeżycia w przypadku nowotworu przełyku. W chirurgii paliatywnej nowotworów przełyku dno żołądka zostaje zespolone poprzecznie z kikutem przełyku. Rozwijające się zwężenie w miejscu zespolenia często uniemożliwia wyleczenie dysfagii. W jednym z badań poświęconych nowotworom przełyku wykazano, iż występowanie tworzącego się zwężenia w przypadku poprzecznego zespolenia przełykowo-żołądkowego wyniosło 13,6%. W związku z częstym występowaniem zwężenia w zespoleniu poprzecznym, wprowadziliśmy nową technikę (zespolenie skośnie), a następnie dokonaliśmy jej porównania z rutynowo stosowanym zespoleniem poprzecznym w prospektywnym badaniu klinicznym z randomizacją.

Materiał i metody: Badanie kliniczne przeprowadzono w szpitalu Imam Hospital (Tabriz, Iran) w latach 2003 i 2008. Badaniem objęto 200 pacjentów z nowotworem przełyku potwierdzonym biopsją. Pacjentów podzielono na dwie grupy równe pod względem liczebności. U wszystkich pacjentów wykonano przezrozworową resekcję przełyku (ang. *transhiatal esophagectomy* – THE) oraz transpozycję żołądka do śródpiersia. W obydwu grupach wykonano szyjne zespolenie przełykowo-żołądkowe z zastosowaniem losowo dobranej metody: poprzecznej (ang. *transverse* – T) lub skośnej (ang. *oblique* – O). Dodatkowo w obydwu grupach wykonano dwuwarstwowe zespolenie szyte ręcznie. Użyto szwów wykonanych z podobnych materiałów: nieabsorbowalnych do warstwy tylnej oraz absorbowalnych do warstwy wewnętrznej.

Wyniki: Badaniem objęto 117 mężczyzn (58,5%) oraz 83 kobiety (41,5%) w wieku średnio 60,47 roku (zakres 28–81 lat). W 6-miesięcznej obserwacji u 25 pacjentów (12,5%) wystąpiła dysfagia [20 (20%) przypadków w grupie T *vs* 5 (5%) przypadków w grupie O (p = 0,001, 95% CI: 0,076–0,586, OR = 0,211].

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in THE than transverse anastomosis. Oblique technique is recommended for anastomosis.
Key words: esophageal cancer, esophageal stricture, dysphagia, oblique esophageal anastomosis, reflux, transverse esophageal anastomosis.
Key words: heart transplantation, troponin, donor's heart.

U 19 pacjentów (9,5%) wystąpiło strukturalne zwężenie zespolenia: 16 (16%) przypadków w grupie T *vs* 3 (3%) przypadki w grupie O (p = 0,002, 95% CI: 0,046–0,577, OR = 0,162).
Wnioski: Niniejsze badanie wykazało, że zwężenie występowało znacząco rzadziej w przypadku zastosowania skośnego aniżeli poprzecznego zespolenia przełykowo-żołądkowego w THE. Polecamy stosowanie techniki skośnej.
Słowa kluczowe: nowotwór przełyku, zwężenie przełyku, dysfagia, zespolenie przełyku skośne, refluks, zespolenie przełyku poprzeczne.

Introduction

Cancer of the esophagus is highly lethal. It is more common in males than females, and becomes more prevalent with increasing age [1, 2]. Esophagectomy improves survival [3]. Transhiatalesophagectomy (THE) and gastric pull-up is the first-line treatment for esophageal cancer [3] and involves cervical anastomosis between the fundus and remnant of the esophagus.The classic anastomosis is constructed non-obliquely (transversely), either hand-sewn or with staples [4]. This technique may be compromised by complications (e.g., leak, stricture, reflux) and influences surgical outcome and recovery.In one study of transverse anastomosis, the prevalence of stricture formation was 13.6% [5].

The expense of stapling devices and the potential higher prevalence of stricture formation in transverse anastomosis persuaded us to introduce oblique anastomosis and compare it with the former. We evaluated differences with respect to sex, age, income, smoking, values of forced expiratory volume in one second (FEV_1), type of malignancy, and tumor site, between patients who had the two types of anastomosis.

Material and methods

This prospective clinical trial was carried out in Imam Hospital in Tabriz, Iran, from Apr. 2003 to Apr. 2008. The study protocol was approved by the Ethical Research Committee of Imam Hospital. Written informed consent was obtained from all patients.

Patients with a pathology report of esophageal cancer who could tolerate surgery and who did not have medical contraindications for surgery were surveyed. Exclusion criteria were: patients with a non-malignant cause (motility disorder) who were candidates for gastric pull-up; candidates for colon interposition; patients who did not undergo surgery due to any cause; and patients who were not discharged from hospital.

Surgery was carried out by the same experienced thoracic surgeon. No patients received neoadjuvant therapy. Two-hundred patients entered the study. They underwent THE with gastric pull-up with oblique anastomosis (100 cases) and transverse anastomosis (100 cases).

Surgical procedure

In the supine position with a pillow under the shoulder and neck, extension laparotomy was done and the abdomen checked. Gastrolysis on the right gastric and right gastroepiploic arteries was completed, along with and pyloromyotomy. The esophagus was blindly released through the hiatus.With a left cervical incision and preservation of the recurrent laryngeal nerve, the cervical esophagus was also blindly released. After esophagectomy, the stomach were pulled up and anastomosed to the esophageal remnant.With identical suture materials, double-layered hand-sewn anastomoses were constructed. For the 100 patients in the transverse (T) group (Fig. 1), the top of the fundus were anastomosed in a transverse line to the esophagus. For the 100 patients in the oblique (O) group (Fig. 2), the fundus were pulled-up and around the esophagus;the esophagus was then invaginated in the fundus with an oblique up-down anastomotic section. After constructing the posterior layer, esophageal myotomy was undertaken 2–3-mm away from the posterior suture

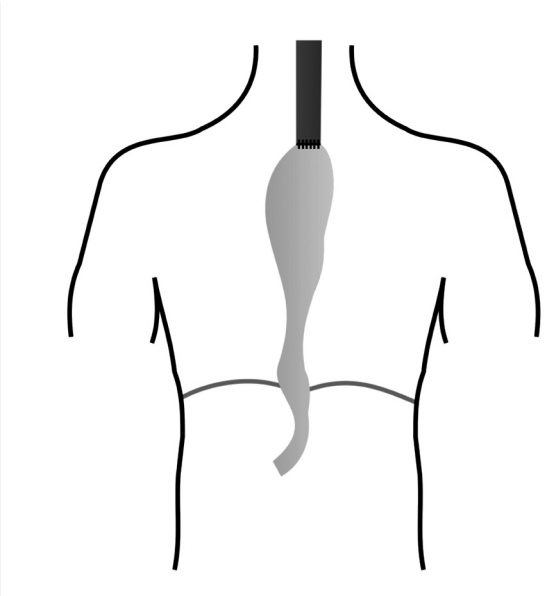

Fig. 1. Transverse anastomosis

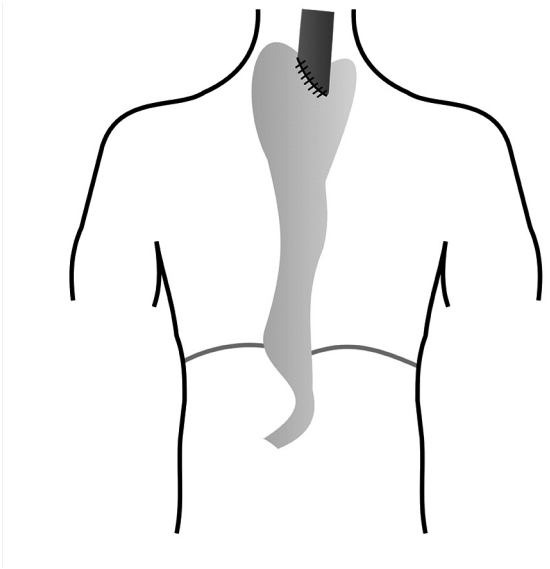

Fig. 2. Obligue anastomosis

line to preserve 5 mm of the mucosa.The inner layer was then completed. The inner and outer layers of the anterior layer were constructed in the usual manner.

Patients were followed up for dysphagia up to six months after hospital discharge. Postoperative dysphagia was evaluated by rigid esophagoscopy or by barium swallow.

Statistical analysis

Student's *t*-test was used for continuous variables. Chi-square test and Fisher's exact test were used for dichotomous variables in this study. Data were analyzed by SPSS 15 (SPSS Inc., Chicago, Illinois). $P < 0.05$ was considered significant.

Results

The study population was 117 males (58.5%) and 83 females (41.5%) with a mean age of 60.47 ±11.20 years (range, 28–81 years). There were 58 males and 42 females in group T, and 59 males and 41 females in group O. Statistically significant differences between the two groups with respect to sex were not observed ($P = 0.886$). The mean age in group T and group O were 60.10 ±11.94 years (range, 28–81 years) and 60.84 ±10.64 years (35–80 years), respectively.A statistically significant difference with respect to age between the two groups was not seen ($P = 0.641$).

Table I shows the income level of the study population. Forty-seven percent of patients in group T and 50% of patients in group O had a low income,7 and 6 cases had a high income, respectively,and 46 and 44 cases had an intermediate income in group T and group O, respectively. These differences were not significant ($P = 0.347$).

Of the 200 cases, 105 (52.5%) had a history of smoking: 53 (53%) cases in group T and 52 (52%) cases in group O.

Table I. Level of income

Level of income*	Oblique group (%)	Transverse group (%)
high	6 (6%)	7 (7%)
intermediate	44 (44%)	46 (46%)
low	50 (50%)	47 (47%)
total	100 (100%)	100 (100%)

**p > 0.05*

Table II. Site of tumor in groups O and T

Site of tumor*	Group O (%)	Group T (%)
Upper third	4 (4.0%)	7 (7.0%)
Middle third	46 (46.0%)	46 (46.0%)
Lower third	50 (50.0%)	47 (47.0%)
Total (%)	100 (100.0%)	100 (100.0%)

** p > 0.05*

Table III. Occurrence of surgical complications

Complication	Group O (%)	Group T (%)	*P*-value
dysphagia	5 (5.0)	20 (20.0)	0.001
reflux	17 (17.0)	15 (15.0)	0.7
structural stricture	3 (3.0)	16 (16.0)	0.002

A significant difference between the groups was not seen ($P = 0.887$).

The mean level of FEV_1 was 75.38 ±8.68% (range 45–100%). The values were 75.90 ±8.18% (range 50–100%) in group T and 74.85 ±9.17% (range 45–99 years) in group O. A significant difference between the groups was not observed ($P = 0.394$).

There were 174 (87%) and 26 (13%) pathology reports compatible with squamous cell carcinoma (SCC) and adenocarcinoma, respectively. There were 91 cases of SCC and 9 cases of adenocarcinoma in group T, and 83 cases and 17 cases of SCC and adenocarcinoma, respectively, in group O. A significant difference between these groups was not detected ($P = 0.93$).

Table II demonstrates the tumor site between the two groups.In both groups, the distal third of the esophagus was the commonest site, and there was no significant difference between the groups ($P = 0.898$). In group T, 7 (7%) cases were in the upper third of the esophagus, 46 (46%) cases were in the middle third, and 47 (47%) cases were in the lower third. In group O, 4 (4%) cases were in the upper third, 46 (46%) cases were in the middle third, and 50 (50%) cases in the lower third.

The total number of cases of postoperative dysphagia was 25 (12.5%, Table III). Of these, 20 cases were in group T and 5 cases were in group O. This difference was significant ($P = 0.001$). A structural stricture was proved by endoscopy or by radiography in 16 out of 20 cases (group T) and 3 out of 5 cases (group O). This difference was significantly

different (P = 0.002). In the 6 remaining cases, no structural stricture was found and all strictures completely recovered.

The total number of patients with a feeling of reflux postoperatively were 15 cases in group T and 17 cases in group O; there was no significant difference between the groups (P = 0.7). Regarding the site and type of tumor in cases with postoperative structural stricture, 12 and 4 cases in group T had a tumor in the middle and distal third, respectively. Fifteen out of 16 cases were SCC and one case was adenocarcinoma. In group O, one case in each third of esophagus specified and all of them were SCC.

Discussion

The prevalence of hand-sewn anastomotic strictu-reshas varied between reports, with values between 48% and 68% (6–9). This study was designed to evaluate an experienced based hypothesis (Mohammadreza Farahnak, personal communication) that oblique anastomosis would reduce occurrence of anastomotic stricture. In the present study,the frequencyof strictures six months after surgery in group T and group O was 16% vs. 3%, and the frequency of dysphagia was 20% vs. 5%, respectively. These differences were significant. In a study in China, one type of oblique anastomosis with semi-invagination was investigated which showed a low prevalence of stricture and reflux, and was associated with a high quality of life [10]. In another study inJapan,the prevalence of strictures in transverse anastomoses in 211 cases was 13.6% [5]. In studies in China (3322 cases) and in Italy (34 cases), theprevalence of strictures with stapled anastomoses was 2% and 0%, respectively [11, 12]. In a comparison between hand-sewn (32 cases) and mechanical anastomosis (31 cases) in Taiwan, strictures were occurred in 14% and 18%, respectively, $p > 0.05$ [13].

Reports show that the prevalence of reflux esophagitis was 30–38% [14–16]. In the present study, based on clinical evaluation, the values in group T and group O were 15% and 17%, respectively ($p > 0.05$).

In many studies, a preference of mechanical over hand-sewn anastomosis has not been proved [17–19]. In a study in the USA, theprevalence of strictures in hand-sewn (43 cases), semi-mechanical (16 cases) and mechanical (34 cases) anastomoses was 58%, 1% and 18%, respectively [20].

Some authors have claimed a relationship between the occurrence of strictures and anastomotic leaks. A lack of monitoring of anastomotic leaks in the present study may be a limitationto the present study [20, 21]. We were not surveying the cause of strictures, so all the factors that have a role in stricture formation (e.g., adjuvant therapy,ischemia) were comparable in both groups. With regard to an "acceptable" prevalence of stricture formation, a lower rate of anastomotic leak was seen in group O.

The prevalence of anastomotic strictures at up to six months follow-up in group T and group O was 16% and 3%, respectively, which was statistically significant. We therefore recommend oblique anastomosis for this type of surgery.

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